

Amendments to the claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Previously presented) A method of generating weighted transmit signals with nulling in a communication system, wherein the communication system includes a transmitter and a plurality of receivers, and wherein the transmitter includes a plurality of antennae, the method comprising:

- a) initializing a parameter set and a weight vector set;
- b) updating the weight vector set based on an inverse cost function, a value of which increases when power calculated as delivered to a target receiver increases and decreases when power calculated as delivered to non-target receivers increases;
- c) updating the parameter set; and
- d) returning to the act (b).

2. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 1, wherein updating the weight vector act (b) is based upon feedback from the receiver.

3. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 2, wherein the communication system adjusts a transmission signal according to the parameter set to enable a receiver feedback.

4. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 1, wherein the communication system comprises a DS-CDMA communication system.

5. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 1, wherein the inverse cost function is represented by the following equation:

$$\text{general inverse cost function} = \frac{\text{delivered power to a desired receiver}}{\text{interference power to all proximate receivers}}.$$

6. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 1, wherein the inverse cost function is represented by the following equation in which w is a weight vector and c is a channel vector, subscript m indicates a particular m^{th} receiver while subscript k varies to reflect K total receivers addressed by the method at a particular time, A_k is an adjustment parameter for adjusting nulling effect for each receiver k , and B is an algorithm gain constant:

$$J = \frac{\left| \mathbf{w}_m^H(i) \mathbf{c}_m(i) \right|^2}{\sum_{k=0}^{K-1} A_k \left| \mathbf{w}_m^H(i) \frac{\mathbf{c}_k(i)}{\|\mathbf{c}_k(i)\|} \right|^2} + B ; \text{ where } J = \text{inverse cost function.}$$

7. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 1, wherein the weight vector is represented by the following equation in which \mathbf{w} is a weight vector and \mathbf{c} is a channel vector, subscript m indicates a particular m^{th} receiver while subscript k varies to reflect K total receivers addressed by the method at a particular time, Φ is a cochannel gain matrix, A_k is an adjustment parameter for adjusting nulling effect for each receiver k , and B is an algorithm gain constant:

$$\mathbf{w}_m = \arg \max_{\substack{\mathbf{w}_m \\ \|\mathbf{w}_m\|=1}} \left(\frac{\left| \mathbf{w}_m^H \mathbf{c}_m \mathbf{c}_m^H \mathbf{w}_m \right|^2}{\mathbf{w}_m^H \Phi \mathbf{w}_m} \right)$$

$$\text{where } \Phi = \sum_{k=0}^{K-1} A_k \mathbf{c}_k \mathbf{c}_k^H + B \cdot \mathbf{I}.$$

8. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 1, wherein the weight vector is represented by the following equation in which \mathbf{w} is a weight vector and \mathbf{c} is a channel vector, subscript k indicates a k^{th} receiver, K total receivers are addressed by the method at a particular time, Φ is a cochannel gain matrix, A_k is an adjustment parameter for adjusting nulling effect for each receiver k , and B is an algorithm gain constant:

$$\mathbf{w}_k = \frac{\Phi^{-1} \mathbf{c}_k}{\|\Phi^{-1} \mathbf{c}_k\|}.$$

$$\text{where } \Phi = \sum_{k=0}^{K-1} A_k \mathbf{c}_k \mathbf{c}_k^H + B \cdot \mathbf{I}.$$

9. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 1, wherein the parameter set comprises a normalized channel estimate and a cochannel gain matrix.

10. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 9, wherein the parameter set further comprises an adjustment parameter for each receiver.

11. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 9, wherein the initialization act (a) comprises initializing the normalized channel estimate according to the following equation in which \mathbf{c}_m is a channel vector for an m^{th} receiver:

$$\hat{\mathbf{c}}_m = \frac{\mathbf{a}}{\|\mathbf{a}\|}; \text{ where } \mathbf{a} \text{ is an arbitrary vector.}$$

12. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 10, wherein the initialization act (a) comprises initializing the adjustment parameter according to a quality of service requirement.

13. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 10, wherein the updating the parameter set act (c) comprises updating the adjustment parameter according to a power control requirement.

14. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 10, wherein the updating the parameter set act (c) comprises updating the adjustment parameter according to the following equation wherein subscript k is an index for a particular receiver, A is a nulling depth parameter, $P^{(T)}$ reflects transmission power, C is an algorithm constant for scaling the effect of transmission power, and D is an algorithm constant based on quality of service considerations:

$$A_k = C_k \left(\frac{1}{P_k^{(T)}} \right) + D_k.$$

15. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 14, wherein $P_k^{(T)}$ is a transmission power for the k^{th} receiver.

16. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 15, wherein $P_k^{(T)}$ is determined through closed loop power control, wherein the receiver transmits power control information to the transmitter.

17. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 14, wherein C_k and D_k are algorithm parameters that are selected to improve performance.

18. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 9, wherein the updating the parameter set act (c) comprises updating the cochannel gain matrix Φ according to the following equation in which \mathbf{c} is a channel vector, subscript k indicates a k^{th} receiver, K total receivers

are addressed by the method at a particular time, A_k is an adjustment parameter adjusting relative effect of each receiver k , and B is an algorithm gain constant:

$$\hat{\Phi} = \sum_{k=0}^{K-1} A_k \hat{\mathbf{c}}_k \hat{\mathbf{c}}_k^H + B \cdot \mathbf{I}.$$

19. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 1, wherein the initialization act (a) comprises initializing the weight vector according to an arbitrary channel estimate vector with a norm of 1.

20. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 1, wherein the updating the weight vector act (b) comprises updating the weight vector according to the following equation in which \mathbf{w} is a weight vector and \mathbf{c} is a channel vector, subscript m indicates an m^{th} receiver, and Φ is a cochannel gain matrix:

$$\mathbf{w}_m \leftarrow \frac{f(\mathbf{w}_m, \mathbf{c}, \hat{\Phi})}{\|f(\mathbf{w}_m, \mathbf{c}, \hat{\Phi})\|}.$$

21. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 20 wherein the update adjusts $[[\mathbf{w}]] \mathbf{w}_m$ towards maximizing an inverse cost which is a function of $[[\mathbf{w}]] \mathbf{w}_m$, \mathbf{c} , and $\hat{\Phi}$.

22. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 21 wherein the maximized inverse cost is given by

$$\frac{|\mathbf{w}_m^H(i) \mathbf{c}_m(i)|^2}{\mathbf{w}_m^H(i) \hat{\Phi} \mathbf{w}_m(i)}.$$

23. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 21 where the update is based upon feedback from the receiver.

24. (Currently amended) A method of generating vector weighted transmit signals with nulling in a communication system, wherein the communication system includes a transmitter and a plurality of receivers, and wherein the transmitter includes a plurality of antennae, the method comprising:

- a) initializing a weight vector for each receiver;
- b) initializing a set of adaptation parameters;
- c) generating a transmit probing signal ~~including alternatively weighted signals transmitted at correspondingly alternative time periods~~ for each particular receiver based on the weight vector and

parameter set for the particular receiver and on channel estimates for each of a plurality of tracked receivers comprising within a subset of tracked receivers of the system;

d) generating feedback based on ~~comparing reception, irrespective of information describing particular transmit weighting vectors, during the alternative time periods of the~~ reception of the corresponding transmit probing signal generated in act (c) for each receiver within the subset of tracked receivers;

e) updating the weight vector employed by the transmitter for each particular receiver based on the feedback generated in act (d) for each receiver; and

f) updating the parameter set by the transmitter based on the weight vector updated in act (e).

25. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 24, wherein the updating the weight vector act (e) comprises the following sub-acts:

- i) updating the weight vector periodically; and
- ii) updating the weight vector upon receiving binary feedback.

26. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 24, wherein the updating the generating the transmit probing signal ~~act sub-act (c)~~ act sub-act (c) comprises the following sub-acts:

- ~~a)-i)~~ i) generating a test perturbation vector; and
- ~~b)-ii)~~ ii) computing an even weight, an odd weight and a data channel weight based on the test perturbation vector generated in sub-act ~~a)(c)(i)~~ a)(c)(i).

27. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 26, wherein the generating sub-act (c)(i) a) ~~a)~~ comprises storing a current value of the test perturbation vector and generating a new current value of the test perturbation vector, \mathbf{v} , according to the following equation in which $E(\mathbf{x})$ is an expected average value of \mathbf{x} :

$$\mathbf{v} \leftarrow \text{test perturbation vector, } E(\mathbf{v}) = 0, E(\mathbf{v}\mathbf{v}^H) = 2\mathbf{I};$$

28. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 27, wherein the updating the weight vector ~~act sub-act (e)~~ act sub-act (e) of claim 24 comprises computing an even weight, an odd weight and a data channel weight based on the stored test perturbation vector.

29. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 26, wherein the test perturbation vector is a Gaussian test perturbation vector.

30. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 26, wherein the computing act (c)(ii) sub-act b) ~~sub-act b)~~ comprises computing an even weight, an odd weight and a

data channel weight according to the following equations in which \mathbf{w} is a weight vector and \mathbf{c} is a channel vector, \mathbf{v} is any perturbation vector, β is a tracking gain constant, $\hat{\Phi}$ is a cochannel gain matrix, subscript *base* indicates a previous value, and subscripts *even* and *odd* denote values perturbed from a previous value:

$$\mathbf{w}_{even} \leftarrow (\mathbf{w}_{base} + \beta \cdot \mathbf{v}) \cdot \sqrt{\frac{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}}{(\mathbf{w}_{base} + \beta \cdot \mathbf{v})^H \hat{\Phi} (\mathbf{w}_{base} + \beta \cdot \mathbf{v})}};$$

$$\mathbf{w}_{odd} \leftarrow (\mathbf{w}_{base} - \beta \cdot \mathbf{v}) \cdot \sqrt{\frac{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}}{(\mathbf{w}_{base} - \beta \cdot \mathbf{v})^H \hat{\Phi} (\mathbf{w}_{base} - \beta \cdot \mathbf{v})}};$$

$$\mathbf{w} \leftarrow \frac{\mathbf{w}_{even} + \mathbf{w}_{odd}}{2}.$$

31. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 30, wherein a weight vector interference normalization is approximated according to the following equations:

Even equation: $\sqrt{\frac{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}}{(\mathbf{w}_{base} + \beta \cdot \mathbf{v})^H \hat{\Phi} (\mathbf{w}_{base} + \beta \cdot \mathbf{v})}} \cong 1 - 2\beta \frac{\text{Re}(\mathbf{v}^H \hat{\Phi} \mathbf{w}_{base})}{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}};$

Odd equation: $\sqrt{\frac{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}}{(\mathbf{w}_{base} - \beta \cdot \mathbf{v})^H \hat{\Phi} (\mathbf{w}_{base} - \beta \cdot \mathbf{v})}} \cong 1 + 2\beta \frac{\text{Re}(\mathbf{v}^H \hat{\Phi} \mathbf{w}_{base})}{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}}.$

32. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 26, wherein the even and odd weight vectors are transmitted with multiplexing, where the even weight vector is applied with an even multiplex and the odd weight vector applied with an odd multiplex.

33. (Original) The method of generating weighted transmit signals with nulling as defined in Claim 32, wherein the even and odd weight vectors are transmitted with time multiplexing, where the even weight vector is applied in even time slots and the odd weight vector is applied in odd time slots.

34. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 25, wherein the updating the weight vector upon receiving binary feedback sub-act (e)(ii) comprises the following sub-acts:

- A)a) receiving a feedback bit;
- B)b) proceeding to a sub-act C)e) if the feedback bit indicates an even channel, else proceeding to a sub-act d);
- C)e) updating a base vector based on an even weight, and proceeding to sub-act E)e);
- D)d) updating the base vector based on an odd weight; and

E)e) computing new values for the even weight, the odd weight and a data channel weight based on the base vector.

35. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 34, wherein the updating a base vector based on an even weight sub-act (e)(ii)(C)-e) comprises updating according to the following equation wherein w is a weight vector, subscript $base$ indicates the base vector value, and subscript $even$ denotes a particular new selected vector value:

$$w_{base} \leftarrow \frac{w_{even}}{\|w_{even}\|}.$$

36. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 34, wherein the updating a base vector based on an odd weight sub-act (e)(ii)(D)-d) comprises updating according to the following equation wherein w is a weight vector, subscript $base$ indicates the base vector value, and subscript odd denotes a particular new selected vector value:

$$w_{base} \leftarrow \frac{w_{odd}}{\|w_{odd}\|}.$$

37. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 34, wherein the computing new values sub-act (e)(ii)(E)-e) comprises computing an even weight, an odd weight and a data channel weight according to the following equations in which w is a weight vector and c is a channel vector, v is any perturbation vector, β is a tracking gain constant, Φ is a cochannel gain matrix, subscript $base$ indicates a previous value, and subscripts $even$ and odd denote values perturbed from a previous value:

$$w_{even} \leftarrow (w_{base} + \beta \cdot v) \cdot \sqrt{\frac{w_{base}^H \hat{\Phi} w_{base}}{(w_{base} + \beta \cdot v)^H \hat{\Phi} (w_{base} + \beta \cdot v)}};$$

$$w_{odd} \leftarrow (w_{base} - \beta \cdot v) \cdot \sqrt{\frac{w_{base}^H \hat{\Phi} w_{base}}{(w_{base} - \beta \cdot v)^H \hat{\Phi} (w_{base} - \beta \cdot v)}};$$

$$w \leftarrow \frac{w_{even} + w_{odd}}{2}.$$

38. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 35, wherein a weight vector interference normalization is approximated according to the following equations in which c is a channel vector, v is any perturbation vector, β is a tracking gain constant, and Φ is a cochannel gain matrix:

$$\begin{aligned} \text{Even equation: } & \sqrt{\frac{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}}{(\mathbf{w}_{base} + \beta \cdot \mathbf{v})^H \hat{\Phi} (\mathbf{w}_{base} + \beta \cdot \mathbf{v})}} \cong 1 - 2\beta \frac{\text{Re}(\mathbf{v}^H \hat{\Phi} \mathbf{w}_{base})}{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}}; \\ \text{Odd equation: } & \sqrt{\frac{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}}{(\mathbf{w}_{base} - \beta \cdot \mathbf{v})^H \hat{\Phi} (\mathbf{w}_{base} - \beta \cdot \mathbf{v})}} \cong 1 + 2\beta \frac{\text{Re}(\mathbf{v}^H \hat{\Phi} \mathbf{w}_{base})}{\mathbf{w}_{base}^H \hat{\Phi} \mathbf{w}_{base}}. \end{aligned}$$

39. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 24 wherein the updating the parameter set act (f) comprises a normalized channel estimate parameter according to the following equation in which subscripts are receiver indices, \mathbf{c} is a channel matrix, \mathbf{w} is a weight vector, and Φ is a cochannel gain matrix:

$$\hat{\mathbf{c}}_m = \frac{\hat{\Phi} \mathbf{w}_m}{\left\| \hat{\Phi} \mathbf{w}_m \right\|}.$$

40. (Currently amended) The method of generating weighted transmit signals with nulling as defined in Claim 24, wherein the updating the parameter act (e) comprises updating a cochannel gain matrix Φ according to the following equation in which \mathbf{c} is a channel vector, subscript k indicates a k^{th} receiver, K total receivers are addressed by the method at a particular time, A is an adjustment parameter adjusting relative effect of each receiver k , and B is an algorithm gain constant:

$$\hat{\Phi} \Leftarrow \sum_{k=0}^{K-1} A_k \hat{\mathbf{c}}_k \hat{\mathbf{c}}_k^H + B \cdot \mathbf{I}.$$

41. (Original) A method of generating weighted transmit signals with nulling in a communication system, wherein the communication system includes a transmitter and a receiver, and wherein the transmitter includes a plurality of antennae, the method comprising:

- a) initializing a plurality of baseband transmit weight vectors and a plurality of channel estimate vectors for multiple tracked transmissions;
- b) updating the plurality of baseband transmit weight vectors based on a metric of a cross interference and a plurality of channel estimates;
- c) updating the plurality of channel estimates based on the plurality of baseband transmit weight vectors; and
- d) returning to act (b).

42. (Previously presented) A communication system, capable of generating weighted transmit signals with nulling, comprising:

- a) a transmitter, capable of initializing a parameter set and a weight vector associated with the transmitter and updating the weight vector based on an inverse cost function, a value of which increases when power calculated as delivered to a target receiver increases and decreases when power calculated as delivered to non-target receivers increases, and updating the weight vector means, and generating even and odd probing signals, for updating the parameter set; and
 - b) a receiver, capable of providing feedback regarding even and odd channel strength.
43. (Currently amended) A transmitter, capable of generating weighted transmit signals with nulling, comprising:
- a) an initializer, adapted to initialize a parameter set and a weight vector associated with the transmitter;
 - b) a first update device, responsive to the initializer, adapted to update the weight vector based on an inverse cost function ~~whose~~ a value of which increases when power calculated as delivered to a target receiver increases and decreases when power calculated as delivered to non-target receivers increases; and
 - c) a second update device, responsive to the updating the weight vector means, adapted to update the parameter set.
44. (Previously presented) An apparatus for generating weighted transmit signals with nulling in a communication system, wherein the communication system includes a transmitter and a receiver, and wherein the transmitter includes a plurality of antennae, comprising:
- a) means for initializing a parameter set and a weight vector associated with the transmitter;
 - b) means, responsive to the initialization means, for updating the weight vector based on an inverse cost function, a value of which increases when power calculated as delivered to a target receiver increases and decreases when power calculated as delivered to non-target receivers increases; and
 - c) means, responsive to the updating the weight vector means, for updating the parameter set.

45. (Original) An apparatus for generating weighted transmit signals with nulling in a communication system, wherein the communication system includes a transmitter and a receiver, and wherein the transmitter includes a plurality of antennae, comprising:

- a) means for initializing a plurality of baseband transmit weight vectors and a plurality of channel estimate vectors for multiple tracked transmissions;
- b) means, responsive to the initialization means, for updating the plurality of baseband transmit weight vectors based on a metric of a cross interference and a plurality of channel estimates; and
- c) means, responsive to the updating the weight vector means, for updating the plurality of channel estimates based on the plurality of baseband transmit weight vectors.

46. (Currently amended) A computer program executable on a ~~general purpose~~ computing device, wherein the program is capable of generating weighted transmit signals with nulling in a communication system, wherein the communication system includes a transmitter and a receiver, and wherein the transmitter includes a plurality of antennae, comprising:

- a) a first set of instructions for initializing a parameter set and a weight vector;
- b) a second set of instructions for updating the weight vector based on an inverse cost function, a value of which increases when power calculated as delivered to a target receiver increases and decreases when power calculated as delivered to non-target receivers increases;
- c) a third set of instructions for updating the parameter set; and
- d) a fourth set of instructions for returning to the act (b).